DC:

Series - Parallel Circuits

Unclassified:

2 Hour Conference W/3Hr. PE 1

Safety & Environmental Impact: “LOW”

DC: Series - Parallel Ckts

Terminal Learning Objective

ACTION: Calculate the DC voltage, DC current, & resistance in a Series - Parallel Circuit.

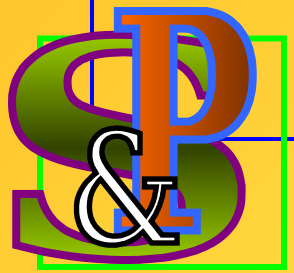
CONDITIONS: Given a classroom environment, Computer Aided Instruction (CAI) workstation, NIDA 130A electronics trainer, digital Multimeter w/test leads, PC-130-9A and PC-130-9B circuit cards, schematic diagrams, calculator and official OMEMS reference materials.

STANDARDS: Be able to identify series - parallel circuits characteristics, calculate voltage, current, and resistance values in a series - parallel circuit, properly measure voltage, current, and resistance in a series - parallel circuit, and compare to calculated values to the established standard of 7 correct answers out of 10 & 8 out of 10 for EOD.

Introduction

A Series-Parallel circuit is a combination of a Series and Parallel circuits. Both series and parallel circuit Voltage, Current and Resistance Laws must be applied to the Series-Parallel circuit.

Keeping electronic systems operating at peak performance will depend upon your knowledge and application of the principles dictating circuit operation.



S &P Rules

DC: Series - Parallel Ckts

Series & Parallel Rules, in Combination;

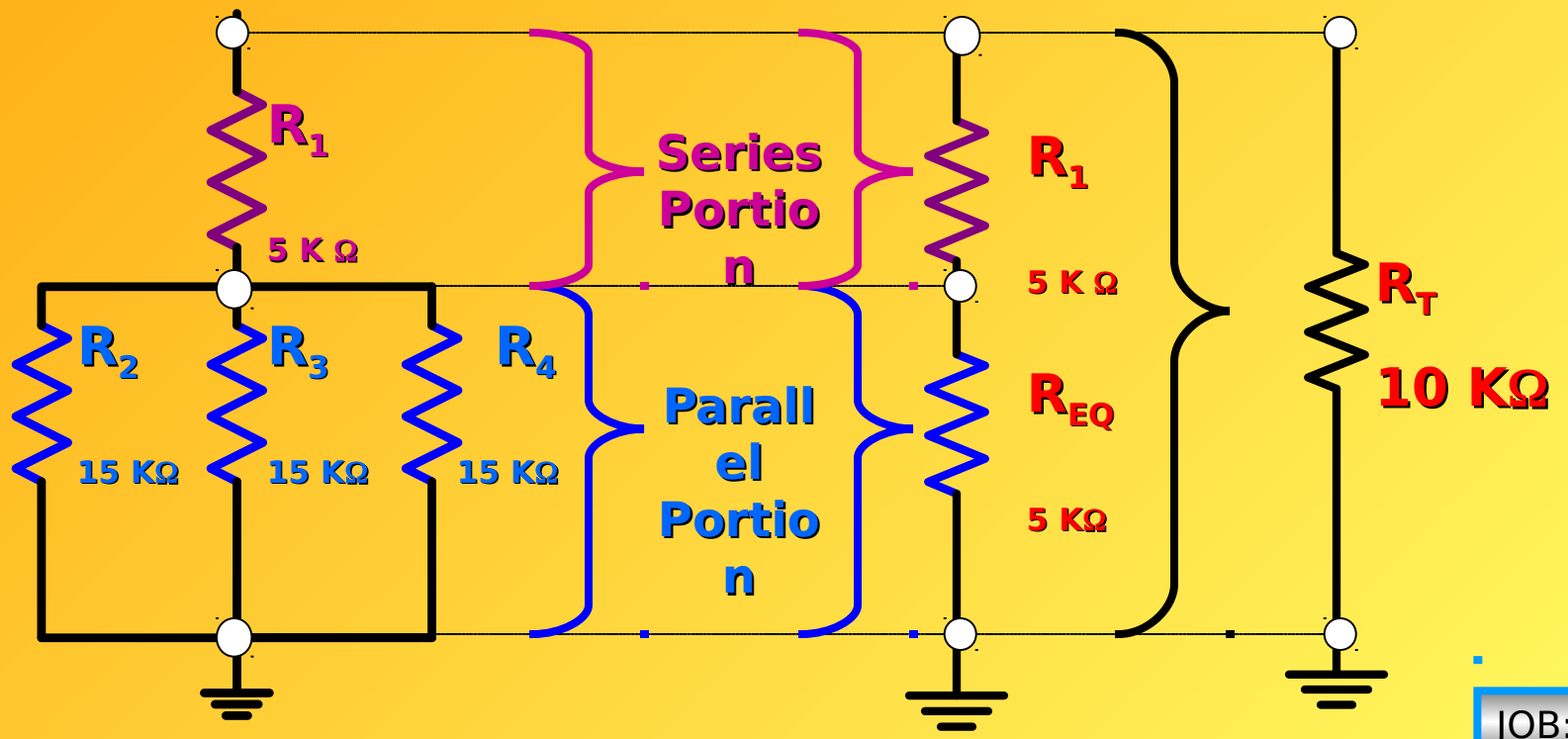
SERIES:	Parallel:
Resistance is Additive to = R_T	**Resistance** is an Equivalency, called the R_{EQ}
Voltage is the Sum of the Resistors Voltage Drops [$E_{R\#}$], to = E_A.	**Voltage** is Constant or the same on each of the Branches, called the E_{REQ} .
Current is Constant, the same throughout the Ckt to = I_T	**Current** is Additive, the sum of the Branch currents is = to I_T

A Key to Success is in the ability to identify which part of the Ckt is Series & which is Parallel, and apply the appropriate rules.

RT

DC: Series - Parallel Resistance

Total Resistance is the reduction of the Parallel portion of the Ckt to the REQ, then Adding the resistors in Series to arrive at the Total Ckt Resistance or RT. [$R_{EQ} + R_1 = R_T$]



JOB: 1 & 2

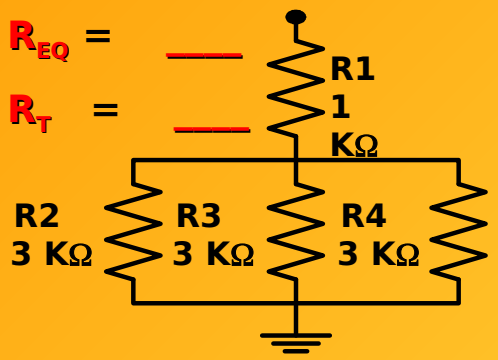
DC: Series - Parallel Resistance

JOB 1: Calculate for the R_{EQ} & R_T In each of the following.

a.

R_{EQ} = ____

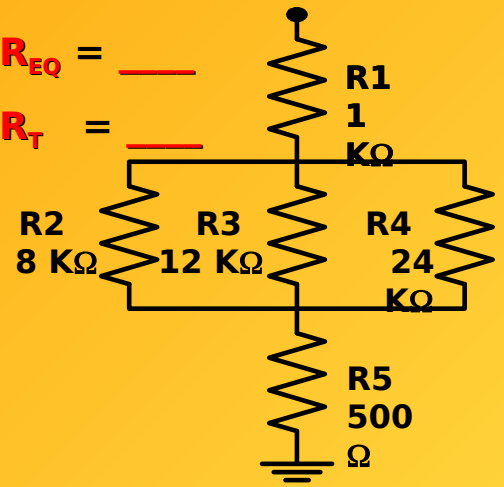
R_T = ____



b.

R_{EQ} = ____

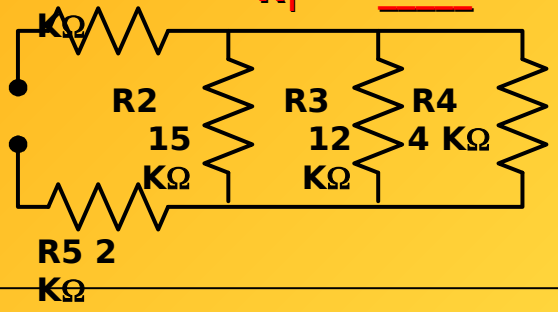
R_T = ____



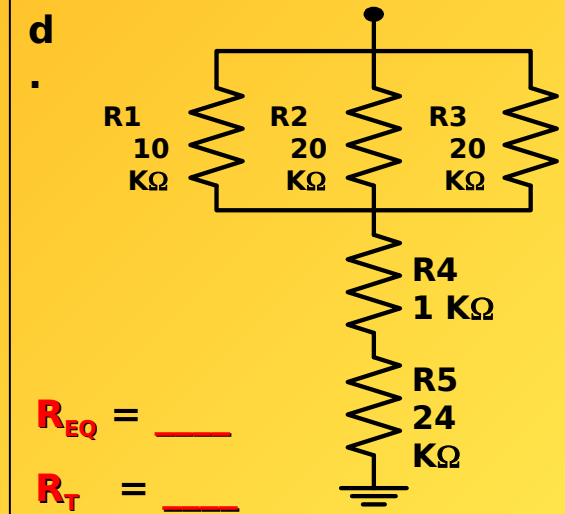
c.

R_{EQ} = ____

R_T = ____



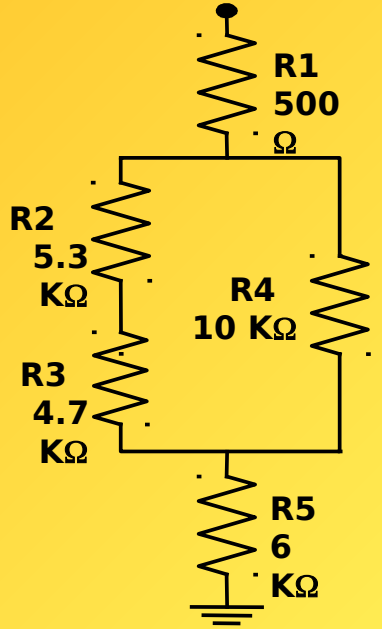
d.



R_{EQ} = ____

R_T = ____

e.



R_{EQ} = _____

R_T = _____

JOB:1 Answers

DC: Series - Parallel Resistance

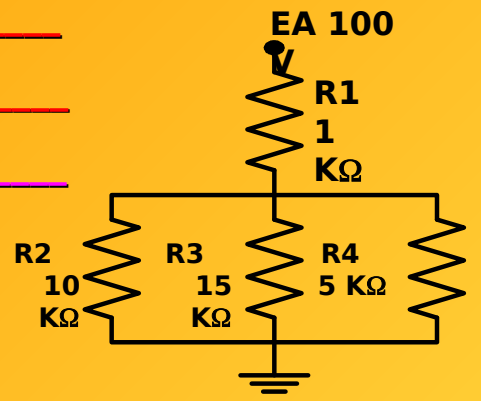
JOB 2: Calculate for R_{EQ}, R_T, & I_T

a.

R_{EQ} = _____

R_T = _____

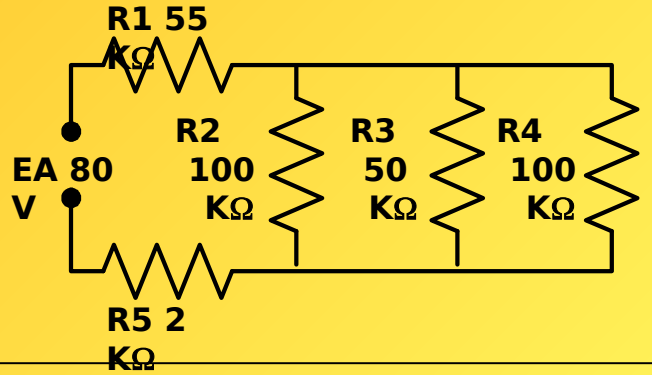
I_T = _____



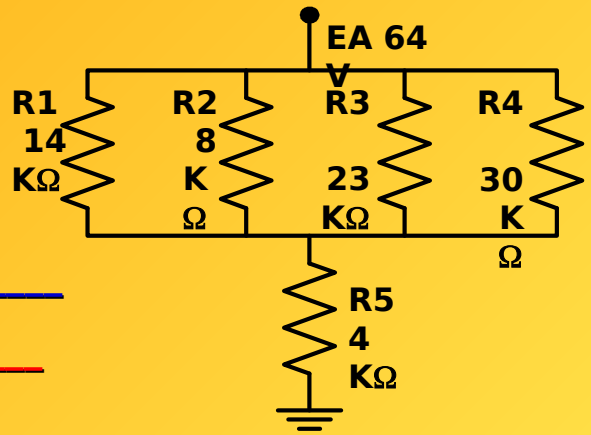
b.

R_{EQ} = _____ I_T = _____

R_T = _____



c.



E_A = _____

R_{EQ} = _____

R_T = _____

I_T = _____

Answers

DC: Series - Parallel Resistance

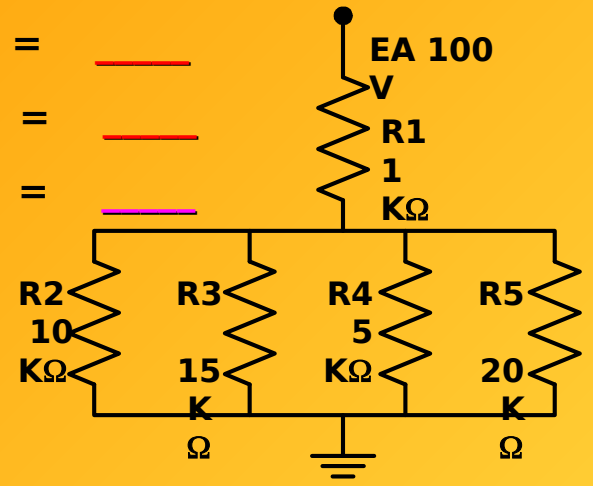
JOB 2: Calculate for R_{EQ}, R_T, & I_T

d

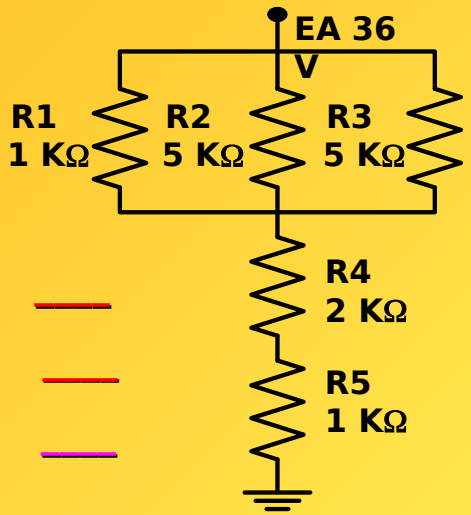
R_{EQ} = _____

R_T = _____

I_T = _____



e.



R_{EQ} = _____

R_T = _____

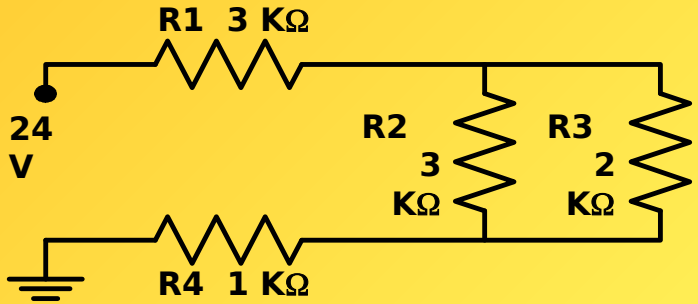
I_T = _____

f.

R_{EQ} = _____

R_T = _____

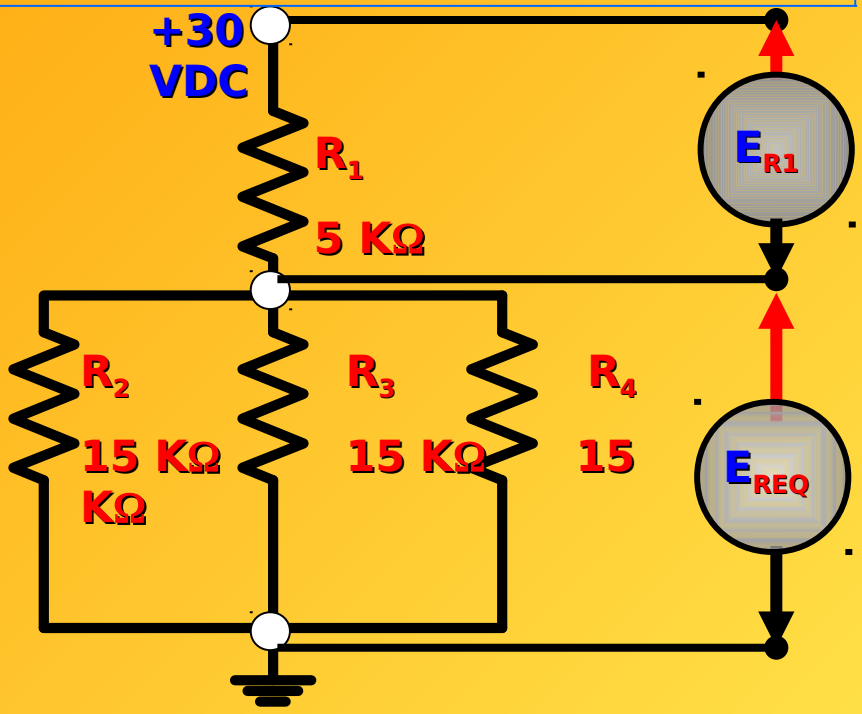
I_T = _____



Answers

DC: Series – Parallel, Voltage Drop

Because the Parallel portion is in Series w/R_1 the Parallel will have its own unique Voltage Drop, the E_{REQ}.



E_A = ___

R_{EQ} = ___ 15 ÷ 3

R_T = ___ $R_1 + R_{EQ}$

I_T = ___ $E_A \div R_T$

E_{R1} = ___ $I_T \times R_1$

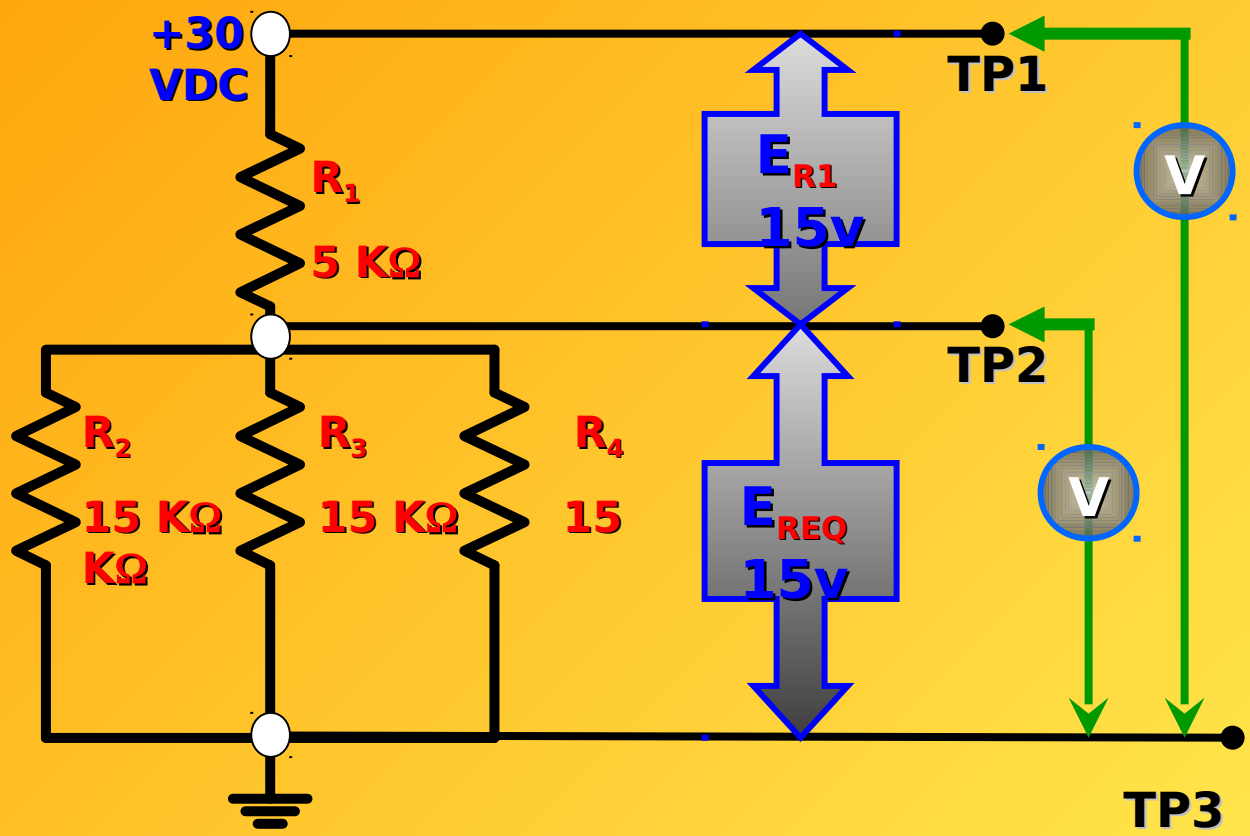
E_{REQ} = ___ $I_T \times R_{EQ}$

Kirchhoff's Law for Voltage:

$$E_{R1} + E_{REQ} = E_A$$

Answers

DC: Series – Parallel, Voltage @ TP



E_A = 30v

R_{EQ} = 5KΩ

R_T = 10KΩ

I_T = 3 mA

E_{R1} = 15v

E_{REQ} = 15v

E_{TP1} = ___

E_{TP2} = ___

E_{TP3} = ___

Voltage @ TP are taken in reference to Ground.

The sum of the individual Voltage Drops of the Resistors between the TP and Ground.

JOB: 3

DC: Series - Parallel Ckts

JOB 3: Calculate for R_{EQ}, R_T, I_T, E_{REQ}, & $E_{R\#}$.

a.

E_A = 120 V

R_{EQ} = ____

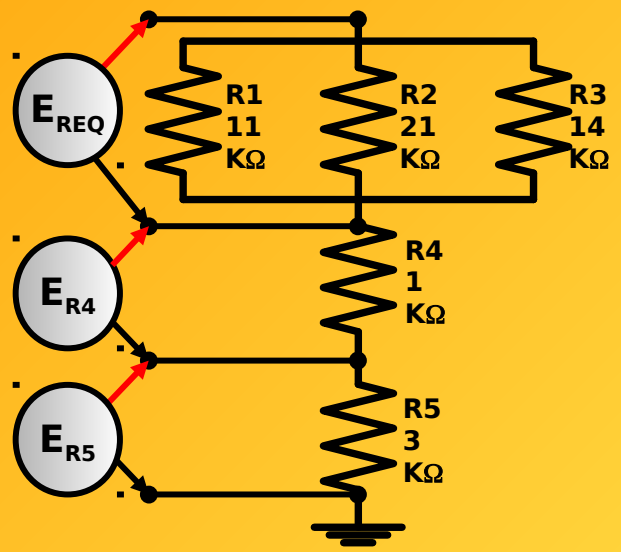
R_T = ____

I_T = ____

E_{REQ} = ____

E_{R4} = ____

E_{R5} = ____



c.

E_A = ____

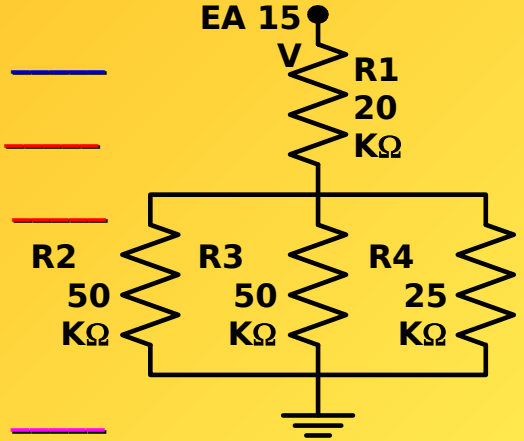
R_{EQ} = ____

R_T = ____

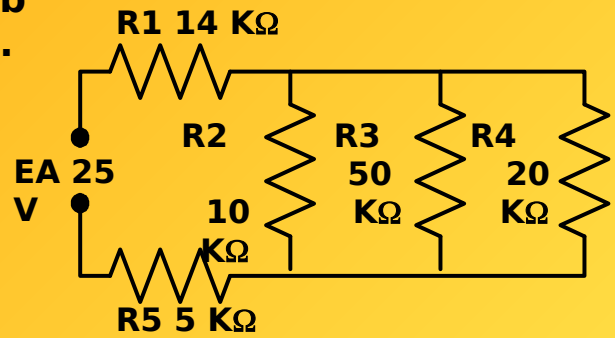
I_T = ____

E_{R1} = ____

E_{REQ} = ____



b.



E_A = ____

R_{EQ} = ____

R_T = ____

I_T = ____

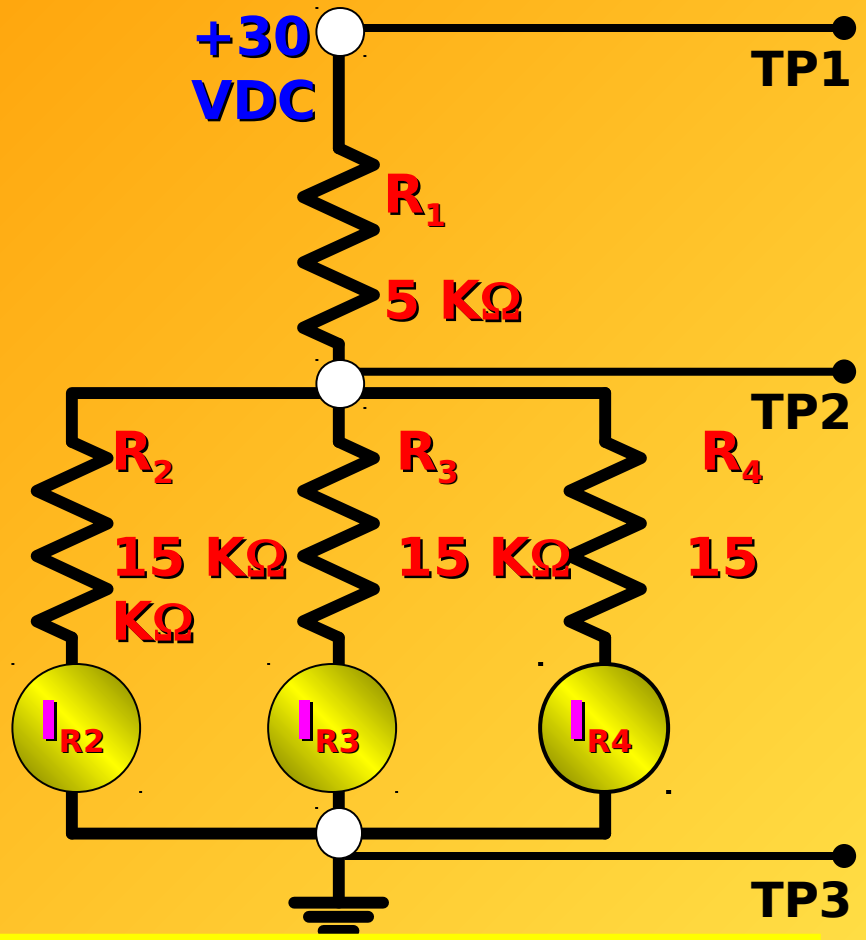
E_{R1} = ____

E_{REQ} = ____

E_{R5} = ____

Answers

DC: Series – Parallel; Current



I_T = 3 mA

E_{R1} = 15v

E_{REQ} = 15v

E_{TP1} = 30v

E_{TP2} = 15v

E_{TP3} = 0v

$I_{REQ} = I_T$

$I_{R2} + {}_3 + {}_4 =$

I_{R2} = ____

I_{R3} = ____

I_{R4} = ____

$E_{REQ} \div R_2$

$E_{REQ} \div R_3$

$E_{REQ} \div R_4$

The Sum of the Branch Currents = I_T

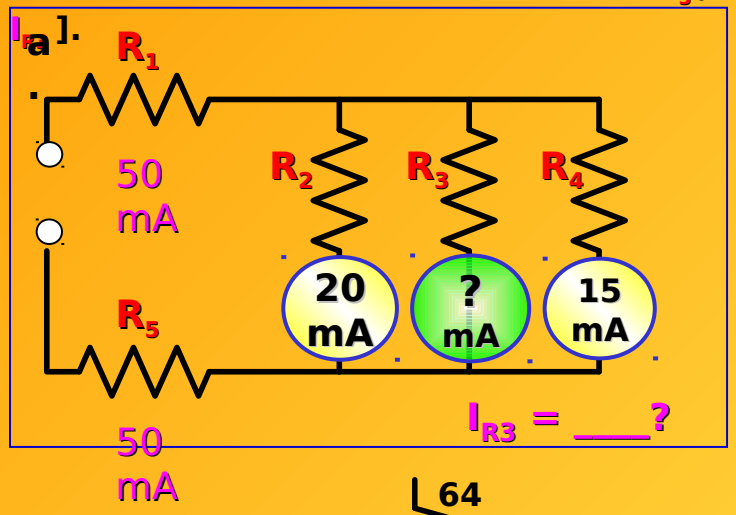
= Value Resistors, $I_T \div 3 = I_{R2, 3, 4}$

JOB: 4

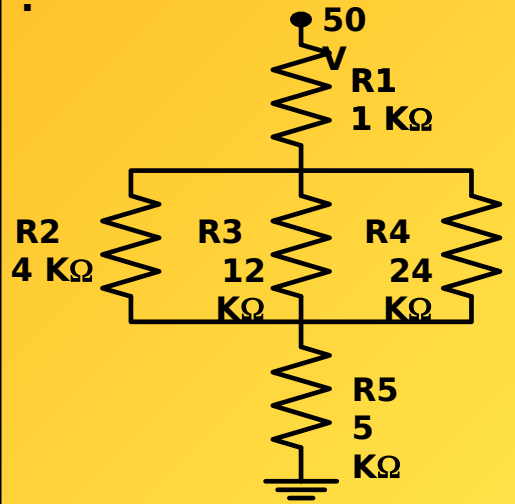
JOB 4: Calculate for Required operating parameters.

Calculate for the Branch Current of R_3, [I_{R3}].

a.



b.



E_A = ____

R_{EQ} = ____

R_T = ____

I_T = ____

E_{R1} = ____

E_{REQ} = ____

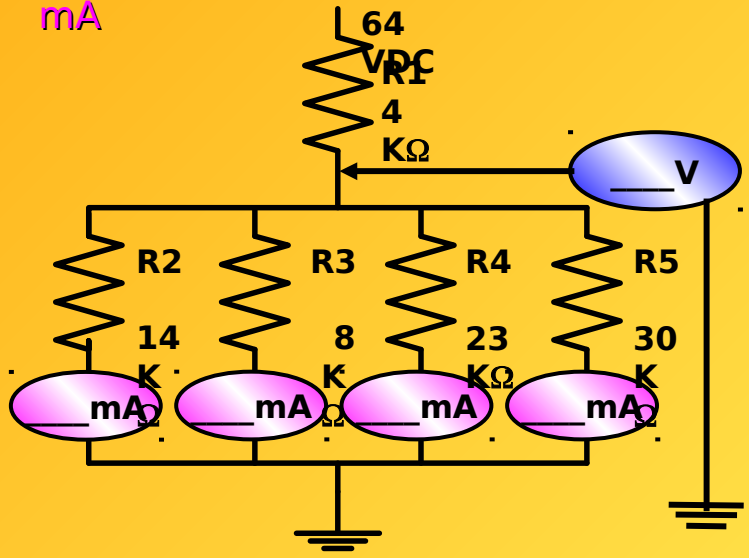
E_{R5} = ____

I_{R2} = ____

I_{R3} = ____

I_{R4} = ____

c.



R_{EQ} = _____

R_T = _____

I_T = _____

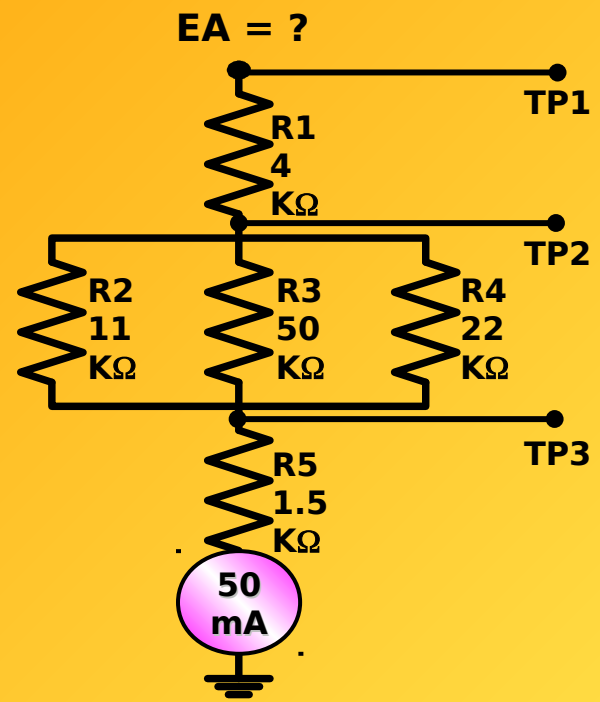
E_{R1} = _____

Answers a, b, c.

DC: Series - Parallel Ckts

JOB 4: d, Calculate for required operating parameters.

d.



E_A = _____

R_{EQ} = _____

R_T = _____

I_T = _____

E_{R1} = _____

E_{REQ} = _____

E_{R5} = _____

E_{TP1} = _____

E_{TP2} = _____

I_{R2} = _____

I_{R3} = _____

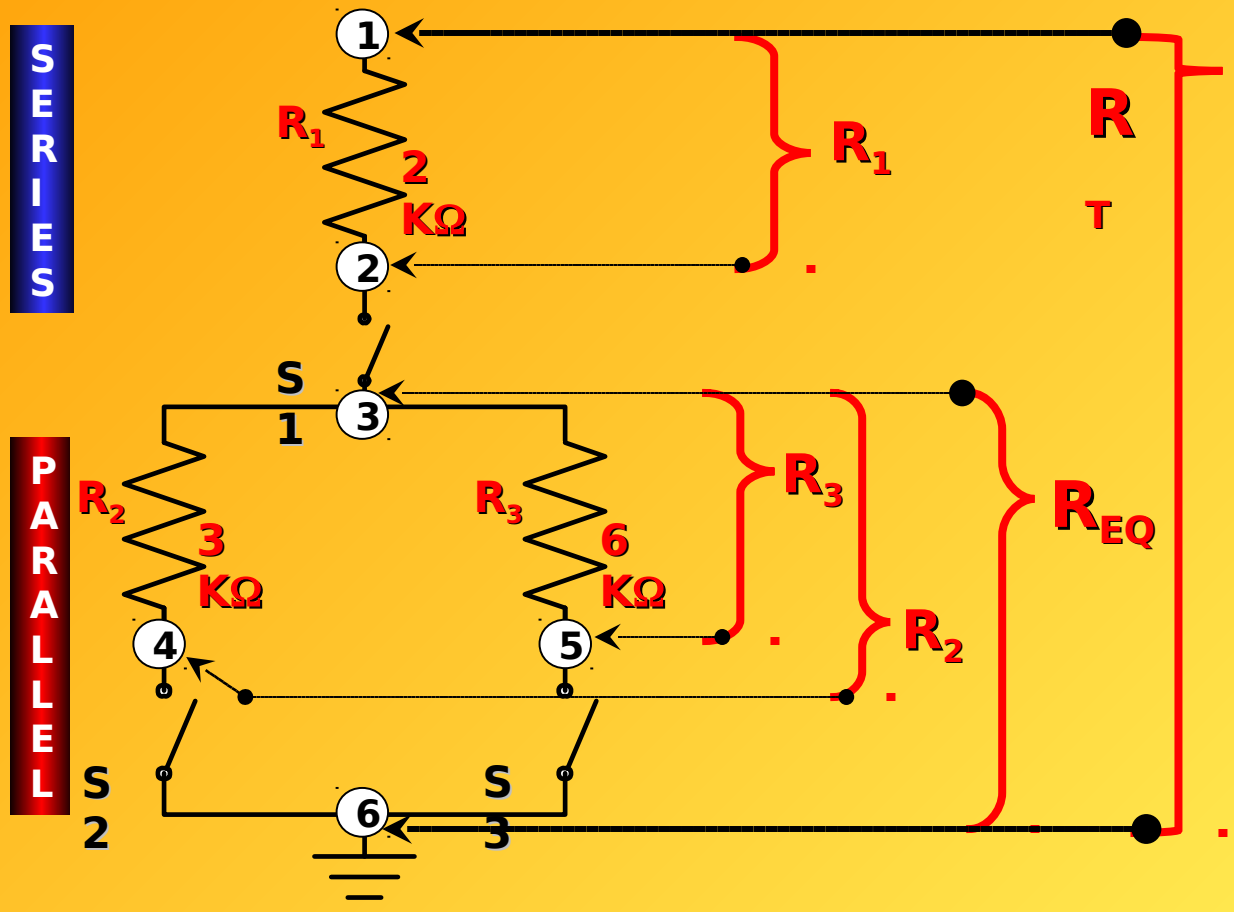
I_{R4} = _____

E_{R3} = _____

Answer d.

DC: Series - Parallel Ckts Concepts

Taking the Measurements; Resistance.



Power; "OFF"

RT; S1, 2, 3, Closed.
TP; 1 – 6

REQ; S1, 2, 3, Closed. **TP;** 3 – 6

R1; S1, Open.
TP; 1 – 2

Resistors in Parallel must be Isolated

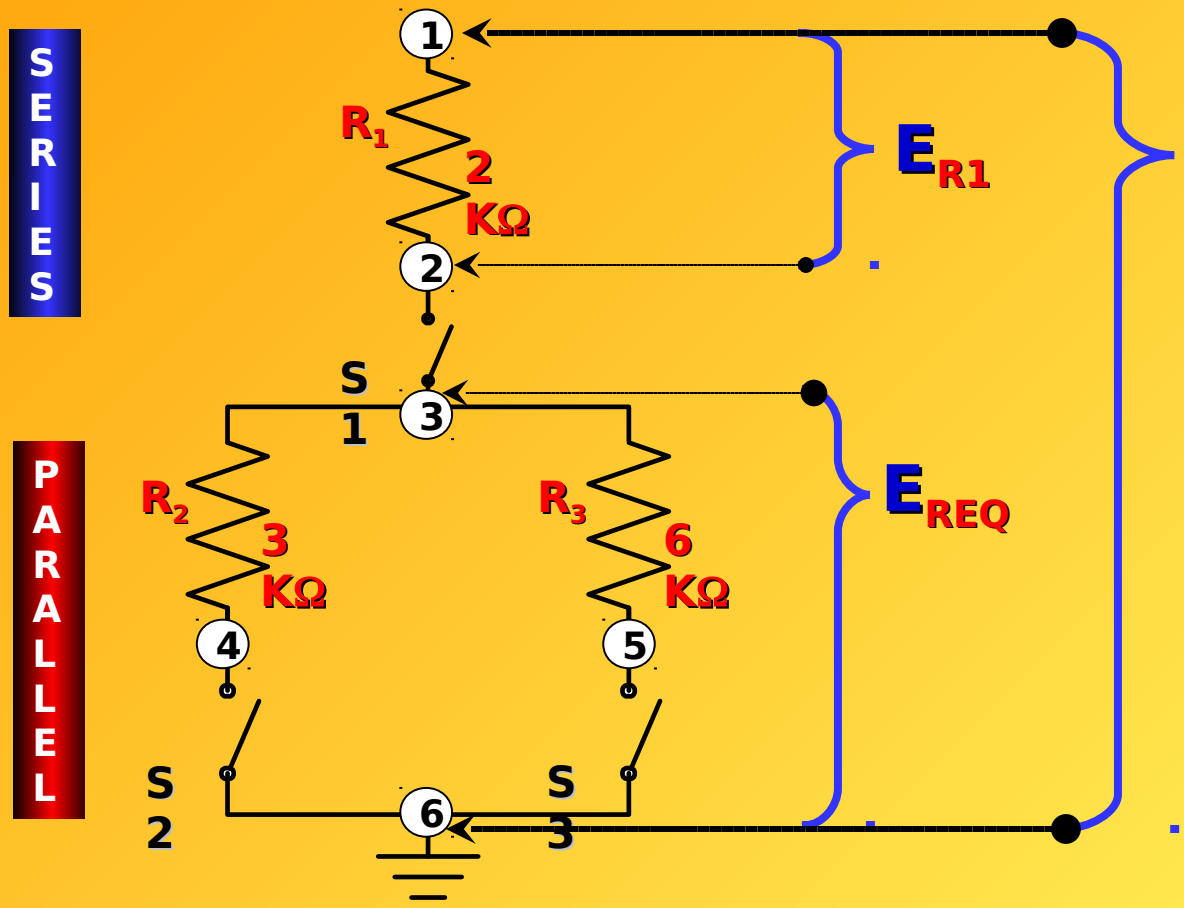
R3; S1, S3 Closed.
S2 Open.
TP; 3 - 5

R2; S1, S2 Closed.
S3 Open.
TP; 3 - 4

Voltage

DC: Series - Parallel Ckts Concepts

Taking the Measurements; Voltage Drops.



Power; "ON"

S1, 2, 3, Closed for all Measurements.

E_A; TP; 1 – 6

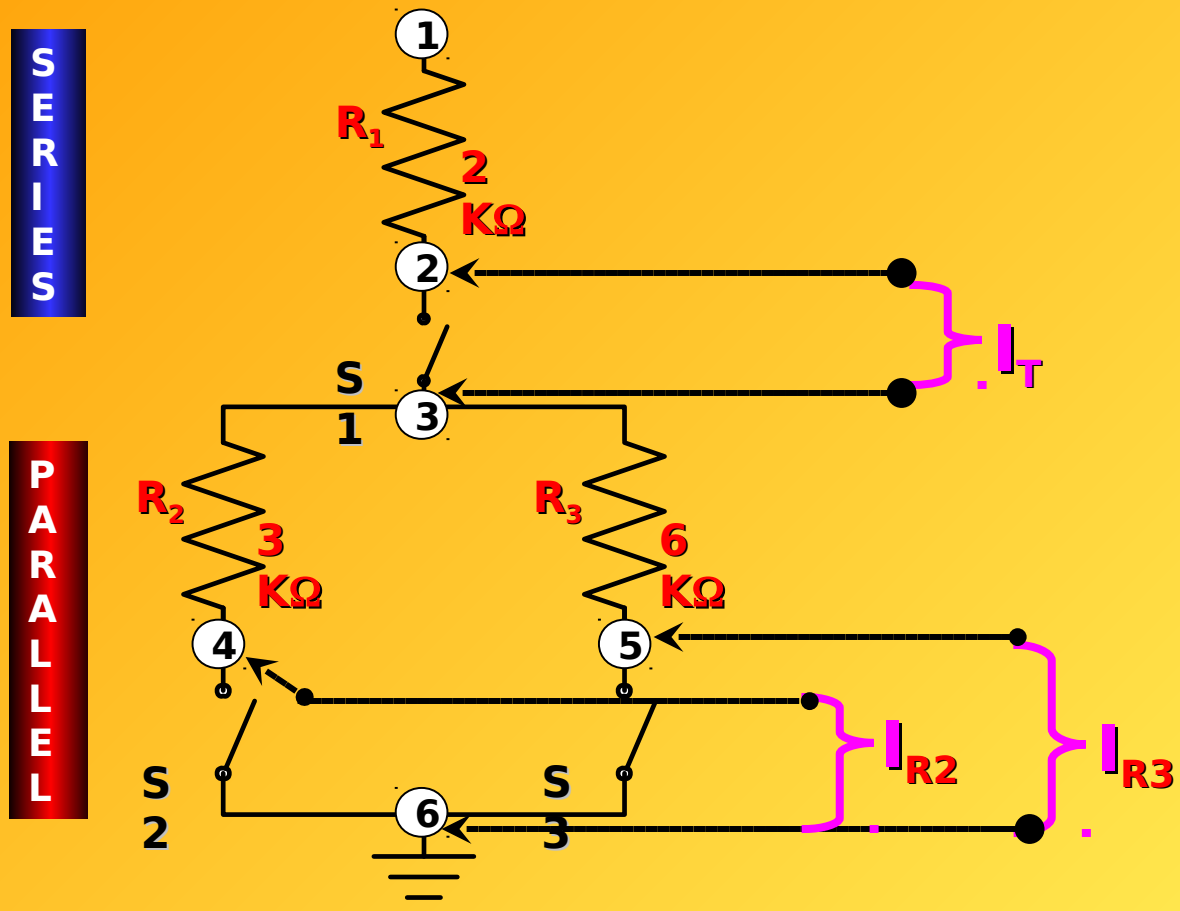
E_{REQ}; TP; 3 – 6

E_{R1}; TP; 1 – 2

Current

DC: Series - Parallel Ckts Concepts

Taking the Measurements; Current.



Power; "ON"

Current is Measured across an OPEN Switch.

I_T; S1 Open. S2, 3, Closed. **TP;** 2 – 3

I_{R3}; S3 Open. S1, S2 Closed. **TP;** 5 - 6

I_{R2}; S2 Open. S1, S3 Closed. **TP;** 4 - 6

9A Card

DC: Series - Parallel Ckts

Lesson Test:

Standard:	**10 Questions, W/in 20 minutes**
	70% Minimum Accuracy.
	80% for EOD.
References:	**Official OMEMS Training Aids.**